AMENDMENTS TO THE CLAIMS

Please cancel claims 1, 2, 4, 5, 17-29, 31, 42 and 45-47 and amend claims 6, 32 and 48 as follows:

1. (Cancelled)

2. (Cancelled)

3. (Cancelled)

4. (Cancelled)

5. (Cancelled)

6. (Currently Amended) An automatic modulation type discrimination apparatus set forth in claim 5, for receiving a reception signal having unknown communication elements and discriminating a modulation type of the reception signal, comprising:

analog/digital modulation type discrimination means for extracting and analyzing a predetermined characteristic from the reception signal and discriminating whether the modulation type of the reception signal is an analog modulation type or a digital modulation type;

analog modulation type discrimination means for, in a case where the reception signal is discriminated to be a signal of the analog modulation type, receiving the discriminated reception signal and discriminating whether the discriminated reception signal is an AM signal or an FM signal;

linear modulation type discrimination means for, in a case where the reception signal is discriminated to be a linear modulation signal of the digital modulation type,

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receiving the discriminated reception signal and discriminating whether the discriminated reception signal is a 16 QAM signal, a BPSK signal, a QPSK signal, a $\pi/4$-shift QPSK signal, an 8-PSK signal, an M-ary PSK signal of multi-level exceeding 8-levels (where, M is a positive integer) or an M-ary QAM signal of multi-level exceeding 16-levels; and

non-linear modulation type discrimination means for, in a case where the reception signal was discriminated to be a non-linear modulation signal by of the digital modulation type, receiving the discriminated reception signal and discriminating whether the discriminated reception signal is an M-ary FSK signal of multi-level exceeding 2-levels, a 2-FSK signal, an MSK signal or a GMSK signal,

the analog/digital modulation type discrimination means including discrimination means for, in a case where the modulation type of the reception signal is discriminated to be the digital modulation type, discriminating whether the reception signal is a linear modulation type signal or a nonlinear modulation type signal,

~~wherein~~ an envelope, a symbol clock and a spectrum characteristic of the reception signal [[are]] being used as the predetermined characteristic.

7. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 6, wherein the analog/digital modulation type discrimination means comprises:

a first envelope detection portion for detecting the envelope from the reception signal;

a first envelope fluctuation determination portion for, after integrating the detected envelope for a specified time, computing its average value and extracting an envelope

fluctuation characteristic by computing a standard deviation of an amplitude distribution characteristic;

a first symbol clock extraction portion for extracting the symbol clock from the reception signal;

a symbol clock determination portion for determining an existence/nonexistence of the symbol clock from an output of the symbol clock extraction portion;

a first spectrum analysis portion for extracting a spectrum waveform of the reception signal and analyzing its characteristic; and

a first modulation type determination portion for, by a characteristic detection result by the first envelope fluctuation determining portion and the symbol clock determination portion and an analysis result of the reception signal by the first spectrum analysis portion, discriminating whether the reception signal is the analog modulation type, the linear modulation type by digital modulation type or the non-linear modulation type by digital modulation type.

8. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 7, wherein the analog modulation type discrimination means includes:

a carrier wave extraction portion for extracting a carrier wave of the reception signal;

a side band spectrum detection portion for detecting a symmetric property of a side band spectrum of the reception signal;

a signal band detection portion for detecting a signal band of the reception signal and analyzing a spectrum shape of the reception signal;

a second envelope detection portion for detecting an envelope of the reception signal;

a second envelope fluctuation determination portion for extracting an envelope fluctuation from the detected envelope;

a second modulation type determination portion for, by using a characteristic extraction and an analysis result of the reception signal from the carrier wave extraction portion, the side band spectrum detection portion, the signal band detection portion and the second envelope fluctuation determination portion, discriminating whether the reception signal is the AM signal, the FM signal or an unknown (unclear) signal not capable of being determined as either of the former signals; and

a first backtracking portion for storing a branch point (branch) of each determination control processing in each of the portions and, in a case where the reception signal is discriminated to be the unknown signal, switching the unknown signal such that a processing for a different modulation type discrimination is performed again by returning to that branch point.

9. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 8, wherein the linear modulation type discrimination means comprises:

a second symbol clock extraction portion for regenerating and extracting a symbol clock from the reception signal;

a first re-sampling portion for re-sampling the reception signal on the basis of the extracted symbol clock and extracting an information-superimposed symbol clock;

a first amplitude distribution extraction portion for computing a symbol vector radius from an extraction result of the first re-sampling portion and extracting its amplitude distribution;

a third modulation type determination portion for, on the basis of an output result of the first amplitude distribution extraction portion, discriminating the 16 QAM signal and the M-ary QAM signal of multi-level exceeding 16-levels from a signal other than the former signals;

an assumed carrier wave synchronization processing portion to which the reception signal discriminated to be the signal other than the 16 QAM signal and the

M-ary QAM signal is inputted and which performs a carrier wave synchronization processing by assuming the modulation type of the reception signal;

a second amplitude distribution extraction portion for receiving an output of the assumed carrier wave synchronization processing portion and extracting characteristics of an (odd number)-th signal symbol and an (even number)-th signal symbol;

a fourth modulation type determination portion for, from a convergence position, a number of convergence points and a characteristic extraction result of the amplitude distribution for every one symbol of the signal symbols after the assumed carrier wave synchronization processing, discriminating whether the reception signal is the BPSK signal, the QPSK signal, the π /4-shift QPSK signal, 8-PSK signal, the M-ary PSK signal of multi-level exceeding 8-levels or an unknown signal not corresponding to the former signals; and

a second backtracking portion for storing a branch point (branch) of each determination processing in the fourth modulation type determination portion and, in a case where the reception signal is discriminated to be the unknown signal, switching the reception

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signal such that a processing for a different modulation type discrimination is performed again by returning to that branch point.

10. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 8, wherein the linear modulation type discrimination means comprises:

a second symbol clock extraction portion for regenerating and extracting a symbol clock from the reception signal;

a first re-sampling portion for re-sampling the reception signal on the basis of the extracted symbol clock and extracting an information-superimposed symbol clock;

a first amplitude distribution extraction portion for computing a symbol vector radius from an extraction result of the first re-sampling portion and extracting its amplitude distribution;

a third amplitude distribution extraction portion for analyzing an amplitude distribution characteristic of the reception signal;

an eighth modulation type determination portion for, on the basis of an extraction result of the first amplitude distribution extraction portion and an analysis result of the third amplitude distribution extraction portion, discriminating whether the reception signal is the 16 QAM signal, the M-ary QAM signal of multi-level exceeding 16-levels, the BPSK signal, the QPSK signal, the π/4-shift QPSK signal, the 8-PSK signal, the

M-ary PSK signal of multi-level exceeding 8-levels or an unknown signal not corresponding to the former signals; and

a second backtracking portion for storing a branch point (branch) of each determination processing in the eighth modulation type determination portion and,

in a case where the reception signal is discriminated to be the unknown signal, switching the reception signal such that a processing for a different modulation type discrimination is performed again by returning to that branch point.

11. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 10, wherein the non-linear modulation type discrimination means comprises:

an FM detection portion for performing an FM detection processing for the reception signal;

a third symbol clock extraction portion for regenerating and extracting a symbol clock from an output of the FM detection portion;

a second re-sampling portion for performing a re-sampling processing of the reception signal on the basis of the extracted symbol clock;

a fourth amplitude distribution extraction portion for extracting an amplitude distribution for a multi-level number determination in the non-linear modulation type from a re-sampled signal;

a fifth modulation type determination portion for performing the multilevel number determination on the basis of an extraction result of the fourth amplitude distribution extraction portion and discriminating an M-ary FSK signal of multi-level exceeding 2-levels from a 2-FSK signal;

a modulation index detection portion for, on the basis of the symbol block extracted in the third symbol clock extraction portion, detecting a modulation index of the reception signal, for the reception signal discriminated to be a signal other than the M-ary FSK signal;

a sixth modulation type determination portion for, from the detected modulation index, discriminating the 2-FSK signal from a signal other than the former signal;

an intersymbol interference analysis portion for analyzing an intersymbol interference in time axis of the reception signal discriminated to be the signal other than the 2-FSK signal;

a second spectrum analysis portion for performing a spectrum analysis of the reception signal and analyzing an intersymbol interference in frequency axis;

a seventh modulation type determination portion for, on the basis of a characteristic extraction and an analysis result of the intersymbol interference analysis portion and the second spectrum analysis portion, discriminating the MSK signal and the GMSK signal from an unknown signal not capable of being judged as either of the former signals; and

a third backtracking portion for storing a branch point (branch) of each determination processing in the seventh modulation type determination portion and, in a case where the reception signal is discriminated to be the unknown signal, switching the unknown signal such that a processing for a different modulation type discrimination is performed again by returning to that branch point.

12. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 11, wherein the first, second, fourth and seventh modulation type determination portions improve a discrimination ability by performing a weighting processing for the characteristic extraction result.

13. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 12, further comprising tuning error correction means provided in a front

stage of the analog/digital modulation type discrimination means, the tuning error correction means comprising:

a third spectrum analysis portion for performing a spectrum extraction and analysis of the reception signal and detecting a center frequency or a carrier wave frequency of the reception signal; and

a frequency correction portion for detecting a tuning error from the detected center frequency or carrier wave frequency and thereby performing an error correction.

14. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 13, wherein first to third storage portions are connected respectively to the first to third backtracking portions, and

each of the first to third backtracking portions recognizes, when the reception signal discriminated to be the unknown signal is inputted, that it is a signal other than the modulation type made an object, and stores the characteristic extraction and the analysis result of the reception signal, which are obtained in the discrimination course, to corresponding one of the first to third storage portions.

15. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 14, further comprising:

elements storage portions that are connected respectively to the third symbol clock extraction portion and the modulation index detection portion in the non-linear modulation type discrimination means,

an elements storage portion is connected, in common, to the intersymbol interference analysis portion and the second spectrum analysis portion, and

means for storing elements, such as symbol clock rate, modulation index and filter parameter, necessary for demodulating the reception signal respectively to a respective storage portion for each element.

16. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 15, further comprising a fourth backtracking portion and a fourth storage portion connected to the first modulation type determination portion in the analog/digital modulation type discrimination means, wherein the reception signal is inputted to the fourth backtracking portion in a case where it cannot be discriminated as either of the analog modulation signal or the digital modulation signal, and the fourth backtracking portion causes communication elements extracted and analyzed in the analog/digital modulation type discrimination means to be stored to the fourth backtracking portion.

17. (Cancelled)

18. (Cancelled)

19. (Cancelled)

20. (Cancelled)

21. (Cancelled)

22. (Cancelled)

23. (Cancelled)

24. (Cancelled)

25. (Cancelled)

26. (Cancelled)

27. (Cancelled)

28. (Cancelled)

29. (Cancelled)

30. (Previously Presented) An automatic modulation type discrimination system having an automatic modulation type discrimination apparatus set forth in claim 16, the automatic modulation type discrimination apparatus being realized by a Digital Signal Processor/Central Processing Unit operating in compliance with a previously recorded program, the automatic modulation type discrimination system being characterized by comprising:

an Analog Digital Converter for quantizing an analog reception signal of intermediate frequency to a digital signal;

a Half Band Filter for performing an orthogonal transformation processing for converting a quantized signal of intermediate frequency into a complex signal of base band zone, a Low Pass Filter processing and a thinning processing of 2;

an NCO type oscillator module for compensating an error of tuning frequency;

a buffer for temporarily storing reception data and smoothly giving the reception data to the digital signal processor/central processing unit;

a clock signal generator; and

a Programmable Logic Device for internally frequency-dividing a clock signal of the clock signal generator and supplying it to each element.

31. (Cancelled)

32. (Currently Amended) An automatic modulation type discrimination method ~~set forth in claim 31,~~ for receiving a reception signal having unknown communication elements and discriminating a modulation type of the reception signal, comprising:

(a) extracting a predetermined characteristic from the reception signal;

(b) discriminating, based on the predetermined characteristics extracted at step (a), whether the modulation type of the reception signal is an analog modulation type or a digital modulation type; and

(c) in a case where the reception signal is discriminated at (b) as being of the digital modulation type, determining whether the reception signal is of the linear modulation type or of the non-linear modulation type,

wherein, the discrimination at step (b) as to whether the reception signal is the analog modulation type or the digital modulation type is performed by means of extracting and analyzing an existence/nonexistence of an envelope, an existence/nonexistence of a symbol clock and a spectrum shape of the reception signal as the predetermined characteristic.

33. (Previously Presented) An automatic modulation type discrimination method set forth in claim 32, in a case where the reception signal is discriminated at (b) to be the analog modulation type, further comprising discriminating whether the reception signal is an AM signal or an FM signal by extracting and analyzing, for the reception signal, an existence/nonexistence of a carrier wave signal, a symmetric property of a side band spectrum, a spectrum concentration property of the reception signal and an existence/nonexistence of an envelope fluctuation and, further, performing a second determination for an analysis result.

34. (Previously Presented) An automatic modulation type discrimination method set forth in claim 33, in a case where the reception signal is determined to be the linear modulation type of the digital modulation type, further comprising discriminating whether the reception signal is a 16 QAM signal, an M-ary QAM signal of multilevel exceeding 16-levels, a BPSK signal, a QPSK signal, a π /4-shift QPSK signal, an 8-PSK signal or an M-ary PSK signal of multi-level exceeding 8-levels by performing, for the reception signal, an extraction and an analysis concerning a distribution of a symbol vector radius by a signal symbol convergence characteristic before a carrier wave synchronization processing, a number of distances thereof, a convergence position of the signal after a carrier synchronization processing, a number of convergence points and a symbol convergence position characteristic of a convergence characteristic for every one symbol and, further, performing a third determination for an analysis result.

35. (Previously Presented) An automatic modulation type discrimination method set forth in claim 34, in a case where the reception signal is determined to be the non-linear modulation type of the digital modulation type, further comprising discriminating whether the reception signal is an M-ary FSK (where, $M \geq 3$) signal, an FSK signal, an MSK signal or a GMSK signal by performing, for the reception signal, an extraction and an analysis concerning an amplitude distribution characteristic after an FM detection, a modulation index, an influence of an intersymbol interference and a kind of the intersymbol interference and, further, performing a fourth determination for an analysis result.

36. (Previously Presented) An automatic modulation type discrimination method set forth in claim 35, wherein, when the reception signal is discriminated as an unknown (unclear) signal not capable of being discriminated as to which modulation type it belongs, further comprising switching the processing such that a discrimination processing is realized by means of another determination using a backtracking technique.

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37. (Previously Presented) An automatic modulation type discrimination method set forth in claim 36, wherein in the backtracking technique a determination point (branch) of a discrimination processing course is stored and a characteristic extraction result until that point of time is used, in a case where there are plural discrimination processing candidates it is possible to select a branch of the processing having a highest probability.

38. (Previously Presented) An automatic modulation type discrimination method set forth in claim 37, in a case where the reception signal is discriminated as the unknown (unclear) signal, further comprising performing a storage of communication elements of that reception signal until that point of time to make it the unknown (unclear) signal a new object signal, and constructing a self-regeneration type data base.

39. (Previously Presented) An automatic modulation type discrimination method set forth in claim 38, the backtracking technique comprises tracing and storing a result, extracting various characteristics and analyzing results of the discrimination processing switched to another discrimination processing.

40. (Previously Presented) An automatic modulation type discrimination method for receiving a reception signal having unknown communication elements and discriminating a modulation type of the reception signal, comprising:

a first step of performing a predetermined characteristic extraction and analysis processing for the reception signal;

a second step of, on the basis of an extraction result and an analysis result, discriminating whether the reception signal is of an analog modulation type, a linear modulation type of the digital modulation type or a non-linear modulation type of the digital modulation type;

a third step of, in a case where in the second step the reception signal is determined to be one of the analog modulation type, performing a preselected characteristic extraction and analysis processing for the reception signal;

a fourth step of, on the basis of a characteristic extracted in the third step and an analysis result, determining whether the reception signal is an AM signal or an FM signal;

a fifth step of, in a case where in the fourth step the reception signal is determined to be an unknown (unclear) signal which is neither the AM signal nor the FM signal, performing a backtracking processing;

a sixth step of, in a case where in the second step the reception signal is determined to be of the linear modulation type of the digital modulation type, performing an extraction of a symbol clock or a re-sampling processing including the extraction of a symbol clock for the reception signal;

a seventh step of, on the basis of a result of the re-sampling processing, computing a symbol vector radius and, further, extracting a characteristic of its amplitude distribution;

an eighth step of, on the basis of an extracted characteristic of the amplitude distribution, determining whether the reception signal is a 16 QAM signal and an M-ary QAM signal of multi-level exceeding 16-levels or a signal other than the former signals;

a ninth step of, in a case where in the eighth step the reception signal is determined to be a linear modulation signal other than the 16 QAM signal and the M-ary QAM signal, assuming the modulation type and performing an assumed carrier wave synchronization processing;

a tenth step of, from a processing result obtained by the ninth step, extracting an amplitude distributions of an (odd number)-th signal symbol and an (even number)-th signal symbol;

an eleventh step of, on the basis of the amplitude distributions extracted in the tenth step, determining whether the reception signal is a BPSK signal, a QPSK signal, a $\pi/4$-shift QPSK signal, an 8-PSK signal or an M-ary PSK signal of multi-level exceeding 8-levels;

a twelfth step of, in a case where in the eleventh step the reception signal is determined to be an unknown signal which is none of the BPSK signal, the QPSK signal, the $\pi/4$-shift QPSK signal, the 8-PSK signal and the M-ary PSK signal, performing a backtracking processing;

a thirteenth step of, in a case where in the second step the reception signal is determined to be the non-linear modulation type by of the digital modulation type, performing an FM detection, a symbol clock extraction and a re-sampling processing;

a fourteenth step of, from a signal re-sampled in the thirteenth step, performing an amplitude distribution extraction processing for a multi-level number determination in the non-linear modulation type;

a fifteenth step of, by performing the multi-level number determination on the basis of an amplitude distribution extracted in the fourteenth step, determining whether the reception signal is an M-ary FSK signal of multi-level exceeding 2-levels or a signal other than the former signal;

a sixteenth step of, in a case where in the fifteenth step the reception signal is determined to be the signal other than the M-ary FSK signal, detecting a modulation index of the reception signal on the basis of a symbol clock extracted in the thirteenth step;

a seventeenth step of, on the basis of the modulation index detected in the sixteenth step, determining whether the reception signal is a 2-FSK signal or a signal other than the former signal;

an eighteenth step of, in a case where in the seventeenth step the reception signal is determined to be the signal other than the 2-FSK signal, analyzing an intersymbol interference in a time axis and an intersymbol interference in a frequency axis;

a nineteenth step of, by an analysis result in the eighteenth step, determining whether the reception signal is an MSK signal, a GMSK signal or an unknown signal; and

a twentieth step of, in a case where in the nineteenth step the reception signal is determined to be the unknown signal, performing a backtracking processing.

41. (Original) A recording medium in which a program for causing a computer to implement the first to twentieth steps set forth in claim 40 has been recorded.

42. (Cancelled)

43. (Previously Presented) An automatic modulation type discrimination method for receiving a reception signal having unknown communication elements and discriminating a modulation type of the reception signal, comprising:

a first step of performing a predetermined characteristic extraction and analysis processing for the reception signal;

a second step of, on the basis of an extraction result and an analysis result, discriminating whether the reception signal is an FM signal of an analog modulation type, an AM signal of the analog modulation type, a linear modulation type of a digital modulation type or a non-linear modulation type of the digital modulation type;

a third step of, in a case where in the second step the reception signal is determined to be of the linear modulation type of the digital modulation type, performing an extraction of a symbol clock or a re-sampling processing including the extraction of a symbol clock for the reception signal;

a fourth step of, on the basis of a result of the re-sampling processing, computing a symbol vector radius and, further, extracting a characteristic of its amplitude distribution;

a fifth step of, on the basis of an extracted characteristic of the amplitude distribution, determining whether the reception signal is a 16 QAM signal and an M-ary QAM signal of multi-level exceeding 16-levels or a signal other than the former signals;

a sixth step of, in a case where in the fifth step the reception signal is determined to be a linear modulation signal other than the 16 QAM signal and the M-ary QAM signal, assuming the modulation type and performing an assumed carrier wave synchronization processing;

a seventh step of, from a processing result obtained by the sixth step, extracting an amplitude distributions of an (odd number)-th signal symbol and an (even number)-th signal symbol;

an eighth step of, on the basis of the amplitude distributions extracted in the seventh step, determining whether the reception signal is a BPSK signal, a QPSK signal, a π /4-shift QPSK signal, an 8-PSK signal or an M-ary PSK signal of multi-level exceeding 8-levels;

a ninth step of, in a case where in the eighth step the reception signal is determined to be an unknown signal which was none of the BPSK signal, the QPSK signal, the π /4-shift

QPSK signal, then 8-PSK signal and the M-ary PSK signal, performing a backtracking processing;

a tenth step of, in a case where in the second step the reception signal is determined to be the non-linear modulation type by digital modulation type, performing an FM detection, a symbol clock extraction and a re-sampling processing;

an eleventh step of, from a signal re-sampled in the tenth step, performing an amplitude distribution extraction processing for a multi-level number determination in the non-linear modulation type;

a twelfth step of, by performing the multi-level number determination on the basis of an amplitude distribution extracted in the eleventh step, determining whether the reception signal is an M-ary FSK signal of multi-level exceeding 2levels or a signal other than the former signal;

a thirteenth step of, in a case where in the twelfth step the reception signal was determined to be the signal other than the M-ary FSK signal, detecting a modulation index of the reception signal on the basis of a symbol clock extracted in the tenth step;

a fourteenth step of, on the basis of the modulation index detected in the thirteenth step, determining whether the reception signal is a 2-FSK signal or a signal other than the former signal;

a fifteenth step of, in a case where in the fourteenth step the reception signal is determined to be the signal other than the 2-FSK signal, analyzing an intersymbol interference in a time axis and an intersymbol interference in a frequency axis;

a sixteenth step of, by an analysis result in the fifteenth step, determining whether the reception signal is an MSK signal, a GMSK signal or an unknown signal; and

a seventeenth step of, in a case where in the sixteenth step the reception signal is determined to be the unknown signal, performing a backtracking processing.

44. (Original) A recording medium in which a program for causing a computer to implement the first to seventeenth steps set forth in claim 43 has been recorded.

45. (Cancelled)

46. (Cancelled)

47. (Cancelled)

48. (Previously Presented) An automatic modulation type discrimination apparatus ~~as set forth in claim 47,~~ for receiving a reception signal having unknown communication elements and discriminating a modulation type of the reception signal, comprising: analog/digital modulation type discrimination means for discriminating whether the reception signal is a signal of the analog modulation type or of the digital modulation type,

the automatic modulation type discrimination apparatus further comprising linear modulation type discrimination means for, in a case where the reception signal is discriminated to be the linear modulation signal of the digital modulation type, receiving the discriminated reception signal and discriminating whether the discriminated reception signal is a 16 QAM signal, a BPSK signal, a QPSK signal, π/4-shift QPSK signal, an 8-PSK signal, an M-ary PSK signal of multi-level exceeding 8-levels or an M-ary PSK signal of multi-level exceeding 16-levels, and

non-linear modulation type discrimination means for, in a case where the reception signal is discriminated to be the non-linear modulation signal of the digital modulation type, receiving the discriminated reception signal and discriminating whether the discriminated

reception signal is an M-ary FSK signal of multi-level exceeding 2-levels, a 2-FSK signal, an MSK signal or a GMSK signal,

wherein the analog/digital modulation type discrimination means comprises:

a first envelope detection portion for detecting an envelope from the reception signal;

an envelope fluctuation determination portion for determining whether the detected envelope is a constant envelope or an inconstant envelope;

a first FM detection portion for performing an FM detection processing for a signal determined as the constant envelope;

a first symbol clock extraction portion for extracting symbol clocks from the signal subjected to the FM detection processing and a signal determined as the inconstant envelope; and

a first modulation type determination portion for, from an amplitude fluctuation characteristic and an existence/nonexistence of the symbol clock, discriminating whether the reception signal is an FM signal of the analog modulation type, an AM signal of the analog modulation type, a linear modulation type by the digital modulation type or a non-linear modulation type by the digital modulation type.

49. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 48, wherein the linear modulation type discrimination means comprises:

a second symbol clock extraction portion for regenerating and extracting a symbol clock from the reception signal;

a first re-sampling portion for re-sampling the reception signal on the basis of the extracted symbol clock and extracting an information-superimposed symbol clock;

a first amplitude distribution extraction portion for computing a symbol vector radius from an extraction result of the first re-sampling portion and extracting its amplitude distribution;

a second modulation type determination portion for, on the basis of an output result of the first amplitude distribution extraction portion, discriminating the 16 QAM signal and the M-ary QAM signal of multi-level exceeding 16-levels

from a signal other than the former signals;

an assumed carrier wave synchronization processing portion to which the reception signal discriminated to be the signal other than the 16 QAM signal and the M-ary QAM signal is inputted and which performs a carrier wave synchronization processing by assuming the modulation type of the reception signal;

a second amplitude distribution extraction portion for receiving an output of the assumed carrier wave synchronization processing portion and extracting characteristics of an (odd number)-th signal symbol and an (even number)-th signal symbol;

a third modulation type determination portion for, from a convergence position, a number of convergence points and a characteristic extraction result of the amplitude distribution for every one symbol of the signal symbols after the assumed carrier wave synchronization processing, discriminating whether the reception signal is the BPSK signal, the QPSK signal, the $\pi/4$-shift QPSK signal, 8-PSK signal, the M-ary PSK signal of multi-level exceeding 8-levels or an unknown signal not corresponding to the former signals; and

a first backtracking portion for storing a branch point (branch) of each determination processing in the third modulation type determination portion and, in a case where the reception signal is discriminated to be the unknown signal, switching the reception signal such that a processing for a different modulation type discrimination is performed again by returning to that branch point.

50. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 48, wherein the linear modulation type discrimination means comprises:

a second symbol clock extraction portion for regenerating and extracting a symbol clock from the reception signal;

a first re-sampling portion for re-sampling the reception signal on the basis of the extracted symbol clock and extracting an information-superimposed symbol clock;

a first amplitude distribution extraction portion for computing a symbol vector radius from an extraction result of the first re-sampling portion and extracting its amplitude distribution;

a third amplitude distribution extraction portion for analyzing an amplitude distribution characteristic of the reception signal;

a fourth modulation type determination portion for, on the basis of an extraction result of the first amplitude distribution extraction portion and an analysis result of the third amplitude distribution extraction portion, discriminating whether the reception signal is the 16 QAM signal, the M-ary QAM signal of multi-level exceeding 16-levels, the BPSK signal, the QPSK signal, the π/4-shift QPSK signal, the 8-PSK signal, the M-ary PSK signal of multi-level exceeding 8-levels or an unknown signal not corresponding to the former signals; and

a first backtracking portion for storing a branch point (branch) of each determination processing in the fourth modulation type determination portion and, in a case where the reception signal is discriminated to be the unknown signal, switching the reception signal such that a processing for a different modulation type discrimination is performed again by returning to that branch point.

51. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 50, wherein the non-linear modulation type discrimination means comprises:

an FM detection portion for performing an FM detection processing for the reception signal;

a third symbol clock extraction portion for regenerating extracting a symbol clock from an output of the FM detection portion;

a second re-sampling portion for performing a re-sampling processing of the reception signal on the basis of the extracted symbol clock;

a fourth amplitude distribution extraction portion for extracting an amplitude distribution for a multi-level number determination in the non-linear

modulation type from a re-sampled signal;

a fifth modulation type determination portion for performing the multilevel number determination on the basis of an extraction result of the fourth amplitude distribution extraction portion and discriminating an M-ary FSK signal of multi-level exceeding 2-levels from a 2-FSK signal;

a modulation index detection portion for, on the basis of the symbol block extracted in the third symbol clock extraction portion, detecting a modulation index of the

reception signal, for the reception signal discriminated to be a signal other than the M-ary FSK signal;

a sixth modulation type determination portion for, from the detected modulation index, discriminating the 2-FSK signal from a signal other than the former signal;

an intersymbol interference analysis portion for analyzing an intersymbol interference in time axis of the reception signal discriminated to be the signal other than the 2-FSK signal;

a first spectrum analysis portion for performing a spectrum analysis of the reception signal and analyzing an intersymbol interference in a frequency axis;

a seventh modulation type determination portion for, on the basis of a characteristic extraction and an analysis result of the intersymbol interference analysis portion and the first spectrum analysis portion, discriminating the MSK signal and the GMSK signal from an unknown signal not capable of being judged as either of the former signals; and

a second backtracking portion for storing a branch point (branch) of each determination processing in the seventh modulation type determination portion and, in a case where the reception signal is discriminated to be the unknown signal, switching the unknown signal such that a processing for a different modulation type discrimination is performed again by returning to that branch point.

52. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 51, wherein the third and seventh modulation type determination portions improve a discrimination ability by performing a weighting processing for the characteristic detection result.

53. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 52, further comprising tuning error correction means provided in a front stage of the analog/digital modulation type discrimination means, wherein the tuning error correction means comprises:

a second spectrum analysis portion for performing a spectrum extraction and analysis of the reception signal and detecting a center frequency or a carrier wave frequency of the reception signal; and

a frequency correction portion for detecting a tuning error from the detected center frequency or carrier wave frequency and thereby performing an error correction.

54. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 53, wherein the first and second storage portions are connected respectively to the first and second backtracking portions, and

each of the first and second backtracking portions recognizes, when the reception signal discriminated to be the unknown signal is inputted, that it is a signal other than the modulation type made an object, and stores the characteristic extraction and the analysis result of the reception signal, which are obtained in the discrimination course, to corresponding one of the first and second storage portions.

55. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 54, further comprising elements storage portions connected respectively to the third symbol clock extraction portion and the modulation index detection portion in the non-linear modulation type discrimination means,

an elements storage portion connected, in common, to the intersymbol interference analysis portion and the first spectrum analysis portion, and

means for storing elements, such as symbol clock rate, modulation index and filter parameter, necessary for demodulating the reception signal respectively to a respective storage portion for each element.

56. (Previously Presented) An automatic modulation type discrimination apparatus set forth in claim 55, further comprising a third backtracking portion and a third storage portion connected to the first modulation type determination portion in the analog/digital modulation type discrimination means, wherein the reception signal is inputted to the third backtracking portion in a case where it cannot be discriminated as either of the analog modulation signal or the digital modulation signal, and the third backtracking portion causes communication elements extracted and analyzed in the analog/digital modulation type discrimination means to be stored to the third backtracking portion.

57. (Previously Presented) An automatic modulation type discrimination system having an automatic modulation type discrimination apparatus set forth in claim 56, the automatic modulation type discrimination apparatus being realized by a Digital Signal Processor/Central Processing Unit operating in compliance with a previously recorded program, the automatic modulation type discrimination system being characterized by comprising:

an Analog Digital Converter for quantizing an analog reception signal of intermediate frequency to a digital signal;

a Half Band Filter for performing an orthogonal transformation processing for converting a quantized signal of intermediate frequency into a complex signal of base band zone, a Low Pass Filter processing and a thinning processing of 2;

an NCO type oscillator module for compensating an error of tuning frequency;

a buffer for temporarily storing reception data and smoothly giving the reception data to the digital signal processor/central processing unit;

a clock signal generator; and

a Programmable Logic Device for internally frequency-dividing a clock signal of the clock signal generator and supplying it to each element.

58. (Previously Presented) An automatic modulation type discrimination method for receiving a reception signal having unknown communication elements and discriminating a modulation type of the reception signal, comprising:

a first step of detecting an envelope for the reception signal;

a second step of determining an existence/nonexistence of an envelope fluctuation concerning the detected envelope;

a third step of performing an FM detection processing for a signal determined that no envelope exists;

a fourth step of extracting a symbol clock from a signal subjected to the FM detection processing;

a fifth step of extracting a symbol clock from a signal determined that the envelope exists;

a sixth step of, from an amplitude fluctuation characteristic and an existence/nonexistence of the symbol clock, discriminating whether the reception signal is an AM modulation signal, an FM modulation signal, a linear modulation signal of a digital modulation type or a non-linear modulation signal of the digital modulation type;

a seventh step of, in a case where in the sixth step the reception signal is determined to be the linear modulation type of the digital modulation type, performing an extraction of a symbol clock or a re-sampling processing including the extraction of a symbol clock for the reception signal;

an eighth step of, on the basis of a result of the re-sampling processing, computing a symbol vector radius and, further, extracting a characteristic of its amplitude distribution;

a ninth step of, on the basis of an extracted characteristic of the amplitude distribution, determining whether the reception signal is a 16 QAM signal and an M-ary QAM signal of multi-level exceeding 16-levels or a signal other than the former signals;

a tenth step of, in a case where in the ninth step the reception signal is determined to be a linear modulation signal other than the 16 QAM signal and the M-ary QAM signal, assuming the modulation type and performing an assumed carrier wave synchronization processing;

an eleventh step of, from a processing result obtained by the tenth step, extracting an amplitude distributions of an (odd number)-th signal symbol and an (even number)-th signal symbol;

a twelfth step of, on the basis of the amplitude distributions extracted in the eleventh step, determining whether the reception signal is a BPSK signal, a QPSK signal, a π /4-shift QPSK signal, an 8-PSK signal or an M-ary PSK signal of multi-level exceeding 8-levels;

a thirteenth step of, in a case where in the twelfth step the reception signal is determined to be an unknown signal which is none of a BPSK signal, a QPSK signal, a π π /4-

shift QPSK signal, an 8-PSK signal and an M-ary PSK signal, performing a backtracking processing;

a fourteenth step of, in a case where in the sixth step the reception signal is determined to be the non-linear modulation type by the digital modulation type, performing an FM detection, a symbol clock extraction and a re-sampling processing;

a fifteenth step of, from a signal re-sampled in the fourteenth step, performing an amplitude distribution extraction processing for a multi-level number determination in the non-linear modulation type;

a sixteenth step of, by performing the multi-level number determination on the basis of an amplitude distribution extracted in the fifteenth step, determining whether the reception signal is an M-ary FSK signal of multi-level exceeding 2-levels or a signal other than the former signal;

a seventeenth step of, in a case where in the sixteenth step the reception signal is determined to be the signal other than the M-ary FSK signal, detecting a modulation index of the reception signal on the basis of a symbol clock extracted in the fourteenth step;

an eighteenth step of, on the basis of the modulation index detected in the seventeenth step, determining whether the reception signal is a 2-FSK signal or a signal other than the former signal;

a nineteenth step of, in a case where in the eighteenth step the reception signal is determined to be the signal other than the 2-FSK signal, analyzing an intersymbol interference in a time axis and an intersymbol interference in a frequency axis;

a twentieth step of, by an analysis result in the nineteenth step, determining whether the reception signal is an MSK signal, a GMSK signal or an unknown signal; and

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a twenty-first step of, in a case where in the twentieth step the reception signal is determined to be the unknown signal, performing a backtracking processing.

59. (Original) A recording medium in which a program for causing a computer to implement the first to twenty-first steps set forth in claim 58 has been recorded.